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ABSTRACT

This automotive electrical and electronic system course is an intermediate course designed for the student who has completed automotive Electrical and Electronic System I. The theory and principles of operation of the components of the starting and charging systems and other electrical accessory systems in the automobile will be learned by the student. Emphasized will be the use of test equipment to diagnose, adjust and repair these components. This nine week (135 clock hours) course is available for two or three credits. Upon completion of the course training will have covered basic automotive electricity, starting systems, charging systems, voltage regulation, and electronic components. Included is a course outline and six pages of post tests. (DS)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-1-28

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Course Outline
AUTOMOTIVE MECHANICS - INTERMEDIATE - 9045
(Automotive Electrical and Electronic System II)
Department 48 - Quin 9045.04

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DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 092703

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1 4 5 0 N O R T H E A S T S E C O N D A V E N U E
M I A M I, F L O R I D A 33132

Course Outline

AUTOMOTIVE MECHANICS - INTERMEDIATE - 9045
(Automotive Electrical and Electronic System II)

Department 48 - Quin 9045.04

county office of
VOCATIONAL AND ADULT EDUCATION

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

December, 1972

Published by the School Board of Dade County

Course Description

9045	48	9045.04	Automotive Electrical and Electronic System II
State Category Number	County Dept. Number	County Course Number	Course Title

This course is designed for the student who has completed Automotive Electrical and Electronic System I (9045.03). The students will learn the theory and principles of operation of the components of the starting and charging systems and other electrical accessory systems in the automobile. The use of test equipment to diagnoze, adjust and repair these components will be emphasized. This is a two or three quinmester credit course.

Indicators of Success: Prior to entry into this course, the vocational student will display mastery of the skills indicated in Automotive Electrical and Electronic System I (9045.03).

Clock Hours: 135

PREFACE

The following quinmester course outline is the second quinmester course available to the student who has satisfactorily completed "Automotive Electrical and Electronic System I."

The total number of hours of instruction is 135, of which approximately 113 hours are for practical application of knowledge and skills. The outline consists of four blocks of instruction, which are subdivided into several units each.

Upon completion of this course, the student will be well trained in the areas of basic automotive electricity, starting systems, charging systems, voltage regulation and electronic components.

The teaching methods will vary according to the ability of the individual student. As the content of this course is flexible, teaching techniques which lend themselves to each particular situation, are employed. The instructor uses demonstrations and lectures supplemented by shop experiments and assignments to the student. The instruction is further developed by the use of films, information sheets and diagrams which will make the instruction more meaningful. Students will disassemble, service, and adjust instructional units under the close supervision of the instructor. Actual service problems will be handled by the students as the instructor will accept live work on a production basis. The bibliography appearing on the last page of this outline lists several references along with supplementary materials.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service, and has been approved by the Dade County Vocational Curriculum Committee.

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with Suggested Hourly Breakdown

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GOALS

The automotive mechanic trainee must be able to demonstrate:

1. The skills and knowledge required to perform maintenance, service and repairs on the automotive starting motor, generators and their related systems.

2. The ability to be accurate and precise when trouble-shooting.

3. The ability to make a diagnosis of the starting motor, generators and their related systems.

4. Positive attitudes regarding the value and dignity of work.

5. Pride and respect of craftsmanship for this occupational field.

6. Safe working habits and proper shop behavior to guard against accidents.

7. An incentive to continue with more advanced training within this occupational field.

8. Knowledge of subject matter by satisfactorily completing the quinmester post-test.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. State the opportunities that are available for careers in the automotive electrical and electronics occupations.
2. State what will be expected of him as an automotive electrical mechanic.
3. Demonstrate understanding and acceptance of his own duties and responsibilities by performing that which is expected of him.

BLOCK II - SERVICE TOOLS, EQUIPMENT AND MATERIALS

The student must be able to:

1. Define the general types of tools and special test equipment and their uses.
2. Use the applicable tools and perform the bench skills in a proper manner.
3. Demonstrate the proper care and maintenance of tools and equipment.
4. State the purpose of each test unit and its proper usage.
5. Practice safety precautions in the use of tools and equipment.

BLOCK III - ELECTRICAL FUNDAMENTALS AND PERFORMANCE

The student must be able to:

1. Identify the individual components that make up the basic electrical automotive system.
2. List the basic fundamentals of the automotive electrical system.
3. Trace the electrical system through a modern automobile.
4. Explain orally or in written form the related systems of automotive electrical systems.
5. Disassemble a starter completely, reassemble and make all adjustments maintaining factory specifications.
6. Diagnose possible cause of starter motor problems when presented with the symptoms.
7. Disassemble a standard generator and alternator completely, make needed repairs, reassemble and make all adjustments maintaining factory specifications.
8. Diagnose the probable cause of charging circuit problems when presented with the symptoms.
9. Diagnose malfunctions in the charging system using the skills learned in the laboratory.
10. Practice recommended safety precautions in the use of tools and test equipment.
11. Check and adjust voltage regulation to maintain factory specifications.

BLOCK IV - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

AUTOMOTIVE MECHANICS - INTERMEDIATE - 9045
(Automotive Electrical and Electronic System II)

Department 48 - Quin 9045.04

I. ORIENTATION

A. Objectives of the Course
   1. Standards (prerequisites)
   2. Methods of evaluation
      a. Written tests
      b. Oral
      c. Manipulation
      d. Diagnosis and performance
   3. Goals and objectives

B. Student Benefits
   1. Opportunities for employment
      a. Scope of trade
      b. Job opportunities
   2. Qualifications for employment
      a. Job competency
      b. Attitude
      c. Dependability
      d. Trade certificate
      e. Experience

C. Student Responsibilities
   1. School policies and expenses
   2. Safety regulations
   3. Shop rules and procedures
      a. Care of hand tools
      b. Use and care of equipment
      c. Reporting defective equipment
      d. Reporting loss of equipment
      e. Materials and supplies
      f. Housekeeping
      g. Appropriate dress
      h. Employee-employer relations
      i. Employee-customer relations

II. SERVICE TOOLS, EQUIPMENT AND MATERIALS

A. Student Hand Tool Kit

B. Special Tools and Diagnostic Equipment
   1. Alternator
   2. Battery post adaptor
   3. Volt-amp tester - hydrometer
   4. Starter battery tester
   5. Coil-condenser tester

6. Tack-dwell meter
7. Test probe light
8. Ohmmeter
9. Soldering tools
10. Crimpring Tools
11. Arbor presses

III. ELECTRICAL FUNDAMENTALS AND PERFORMANCE

A. Review of the Components and Fundamentals
1. Electron theory
2. Ohm's Law
3. Basic electrical circuits
4. Magnetism
5. The measurement of electricity
6. Automotive electrical circuit
7. Automotive electronics
8. Battery servicing
9. Ignition system
10. Accessory circuits

B. Location and Identification of Electrical and Electronic Components
1. Starter
2. Alternator
3. Voltage regulator
4. Ignition system
5. Gauges
6. Accessories

C. Battery Test Procedures
1. Visual inspection
2. Hydrometer test
3. Light load test
4. Capacity testing with carbon pile battery-starter tester
5. Electronic hydrometer - allowance limits

D. The Starting System
1. Unit identification of the starting motor
   a. Component parts and nomenclature
   b. Basic types of starting motors
2. Starter motor drives
   a. Bendix and follow through types
   b. Overrunning clutch type
3. Bench testing starting motor
   a. Armature
   b. Field coils
   c. Drive units
   d. Switches
   e. Minor parts
   f. Growler and continuity light test
4. Starting motor field coil design
   a. Series field
   b. Series shunt fields

c. Double shunt fields
d. Movable pole shoe type

5. Starting motor control switches
   a. Ignition switches
   b. Solenoid (electromagnetic) switches
   c. Mechanical switches
6. Trouble shooting the starting system
   a. Battery-starter tester
   b. Voltmeter
   c. Techniques of using the manufacturer's specifications and testing the system
7. Servicing starter motor and bench repair
   a. Soldering brushes and terminals
   b. Installing new fields
   c. Installing new armature
   d. Installing new bushings
   e. Installing new starter drive units
   f. Testing upon completion of reconditioning
   g. Testing bench repair

E. The Charging System
1. Unit identification of the charging system
   a. Generator nomenclature
   b. Component parts
2. Generator fundamentals (D.C.)
   a. Basic theory of current
   b. Theory of generator design
   c. Relationship of polarity and the magnetic field
3. Bench testing the generator
   a. Growler and continuity light tester
   b. Ohmmeter
   c. Generator test bench
4. Servicing the generator
   a. Armature
   b. Field coil
   c. Bearings and bushings
   d. Brushes and minor parts
5. Reassembling and testing
6. Alternator fundamentals (A.C.)
   a. Basic theory of A.C. currents
   b. Theory of alternator design
   c. Relationship of polarity and magnetic fields
   d. Semiconductor theory
      (1) N-type and P-type materials
      (2) Hole theory and current flow
      (3) Diode structure and operational theory
      (4) Transistor structure and operational theory
      (5) Basic solid state circuits
      (6) Basic tests and test precautions
7. Bench testing the alternator
   a. Growth and continuity light tester
      (1) Diodes

(2) Stator
(3) Rotor

b. Ohmmeter
c. Generator/alternator test bench

8. Servicing the alternator
   a. Rotor
   b. Stator
   c. Diode replacement
   d. Slip ring
   e. Bearing replacement
   f. Brushes
   g. Heat sink replacement
9. Reassembling and testing
   a. On car testing
   b. Bench testing

F. Voltage Regulation (Charging System Control)
1. Basic theory of all regulation
   a. Reverse current relay, current limiter and voltage limiter
   b. Double contact voltage limiter and test precautions
   c. Transistor type regulator and test precautions
2. Adjusting the regulator
   a. Using test equipment
   b. Using jumper lead
3. Trouble shooting the charging system
   a. Hooking up test equipment
   b. Precautions to be observed in testing the alternator
   c. Manufacture specifications and interpret test results
   d. Care of test equipment and maintenance
4. Testing and servicing accessories and gauges
   a. Motors
   b. Fuel gauge
   c. Instrument gauges
   d. Miscellaneous switches
      (1) Ignition switch
      (2) Stop light switch
      (3) Electric window lift switch
      (4) Electric seat switch
      (5) Light switch
      (6) Fuse block

IV. QUINMESTER POST-TEST

BIBLIOGRAPHY
(Automotive Electrical and Electronic System II)

Basic References:

1. Crouse, William H. Automotive Electrical Equipment. New York: McGraw-Hill Book Company, Inc., 1966. Pp. 489.

2. _____. Automotive Mechanics. New York: McGraw-Hill Book Company, Inc., 1965. Pp. 616.

3. Wetzel, Guy F. Automotive Diagnosis and Tune-Up. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1969. Pp. 450.

Manuals:

4. Automotive Electricity. Chicago: DeVry Industries, Inc. Yearly.

5. Automotive Tune-Up Principles and Procedures. Evanston, Illinois: Ignition Manufacturers Institute. Yearly.

6. Chilton Auto Repair Manual. Philadelphia: Chilton Co. Yearly.

7. Glen Auto Repair Manual. Philadelphia: Chilton Co. Yearly.

8. Motors Auto Repair Manual. New York: Motor Magazine. Yearly.

Films:

1. Basic Electricity. 16 mm. 20 min. Color. United World Films, Inc. 1-12962.

2. Current and EMF. 16 mm. 11 min. B/W. United World Films, Inc. 1-05504.

3. Diode: Principles and Application, The. 16 mm. 17 min. B/W. United World Films, Inc. 1-12988.

4. Electron: An Introduction. 16 mm. 16 min. B/W. United World Films, Inc. 1-03541.

5. Elements of Electrical Circuits. 16 mm. 11 min. B/W. Encyclopedia Britannica Films, Inc. 1-01892.

6. Elements of Electricity. 16 mm. 15 min. Color. United World Films, Inc. 1-13001.

7. Magnetic Force. 16 mm. 29 min. Color. 1-30321.

8. Magnetism. 16 mm. 16 mm. B/W. Encyclopedia Britannica Films, Inc. 1-10744.

9. Ohm's Law. 16 mm. 19 min. B/W. United World Films, Inc. 1-13196.

10. Principles of Electricity. 16 mm. 20 min. Color. General Electric Company. 1-13111.

11. Principles of Operation of a Generator Regulator. 16 mm. 13 min. B/W. United World Films, Inc. 1-13115.

12. Series and Parallel Circuits. 16 mm. 8 min. B/W. United World Films, Inc. 1-05566.

13. Volts, Amps and Ohms. 16 mm. 8 min. B/W. United World Films, Inc. 1-13178.

Transparencies:

1. Automotive Mechanics: A Standard Alternator Assembly. C, ST, DCA #2-00364.

2. Automotive Mechanics: A Standard Generator Assembly. C, ST, DCA #2-00363.

3. Automotive Mechanics: A Standard Starting Motor. C, ST, DCA #2-00365.

A P P E N D I X

Quinmester Post-Test Sample

QUINMESTER POST-TEST

Name _____ Date _____ Score ____

Multiple Choice Test Items

Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the letter of the choice you make in the space provided at the left edge of the sheet.

____ 1. The battery capacity test is made with:

a. An ohmmeter and ammeter
b. Hydrometer and voltmeter
c. A load on the battery
d. The engine running

____ 2. Electrolyte used in automotive storage batteries is a mixture of:

a. Hydrochloric acid and water
b. Acetric acid and water
c. Sulphuric acid and water
d. Bicarbonate of soda and water

____ 3. A flow of electrical current can be generated by combining three factors: (1) a magnetic field, (2) a conductor and (3):

a. Pressure
b. Motion
c. Force
d. Proximity

____ 4. The testing device used in testing the solution in an automotive storage battery should read when in charged condition approximately:

a. 1.125 sp.
b. .820 sp.
c. 1.025 sp.
d. 1.280 sp.

____ 5. If a battery in a particular vehicle constantly needs water you should suspect:

a. The voltage regulator-adjustment might be too high.
b. The current regulator adjustment allows too much alternating current into the battery
c. The thermostat is allowing the engine to heat up too much
d. None of the above.

____ 6. Extreme care should be exercised around a charging battery since a spark could cause:

a. The battery to run down
b. The gases to explode
c. A high tension shock to the mechanic
d. The alternator diodes to burn out

____ 7. When testing a starter, what maximum voltage drop should you expect between the battery and starter terminal if the battery is fully charged:

a. 9 volts
b. 5 volts
c. .5 volts
d. None of the above

____ 8. While reconditioning a starter motor, it is noticed that the armature has rubbed against the field coil poles, you should:

a. Do nothing as this is normal
b. Overhaul the armature in a lath
c. Replace the shaft bushings
d. Replace the starter

____ 9. What cause excessive amperage draw by the starting motor:

a. An open field
b. A grounded bendix
c. A burned commutator
d. A short in the armature

____10. Twelve volt starter motor draw about:

a. 50 amperes
b. 750 amperes
c. 150 amperes
d. 550 amperes

____11. The two brush generator voltage output regulation is achieved by:

a. Field strength
b. Armature voltage
c. Battery voltage
d. None of the above

____12. The generagor commutator should be cleaned up with:

a. Emery paper
b. Sand paper
c. Mineral spirits
d. A flat file

____13. The voltage regulator controls current output to about:

a. 12 volts
b. 100 amperes
c. 15 volts
d. 40 amperes

____14. An alternator will produce current at a:

a. High rpm
b. Very high rpm
c. Medium rpm
d. Low rpm

____15. The controlling unit necessary for an alternator is:

a. Voltage regulator
b. Ballast resistor
c. Cutout relay
d. None of the above apply

____16. Current is produced by the alternator by:

a. Moving conductors through a stationary magnetic field
b. Moving a magnetic field through diodes
c. Moving a magnetic field through a stationary conductor
d. The usage of slip rings rather than a commutator

____17. Output current of an alternator is produced in the:

a. Heat sink
b. Rotor field windings
c. Diodes
d. Stator windings

____18. The purpose of the diode is to:

a. Polarize the alternator field
b. Control maximum amperes output
c. Rectify the output current
d. None of the above

____19. Testing an alternator field coil for continuity you could use:

a. 12 volt test light
b. A growler
c. Voltmeter
d. Variable resistor

___20. The purposes of the ballast resistor is to:

a. Suppress radio and TV static
b. Is a part of the secondary circuit
c. Is a spark gap
d. Controls voltage in the primary circuit

____21. The current regulator has a:

a. Series winding
b. Shunt winding
c. Series and shunt winding
d. None apply

____22. The windings of the current regulator carry about:

a. One-half the generator output
b. Full field current
c. All current output
d. No current output

____23. Increasing voltage regulator spring tension will:

a. Increase maximum current output
b. Increase relay closing voltage
c. Increase relay opening current
d. Increasing voltage

____24. To polarize a type A generator:

a. Momentarily jump from the battery to armature terminals
b. Momentarily jump from battery to field
c. Disconnect field and touch to battery terminal
d. None of the above

____25. To determine whether charging circuit trouble is in the generator or regulator you would first make a:

a. Output test
b. Relay test
c. Voltage regulator test
d. Current regulator test

ANSWER KEY TO QUINMESTER POST-TEST

1. c
2. c
3. b
4. d
5. a
6. b
7. c
8. c
9. d
10. c
11. a
12. b
13. d
14. d
15. a
16. c
17. d
18. c
19. a
20. d
21. a
22. c
23. d
24. a
25. a